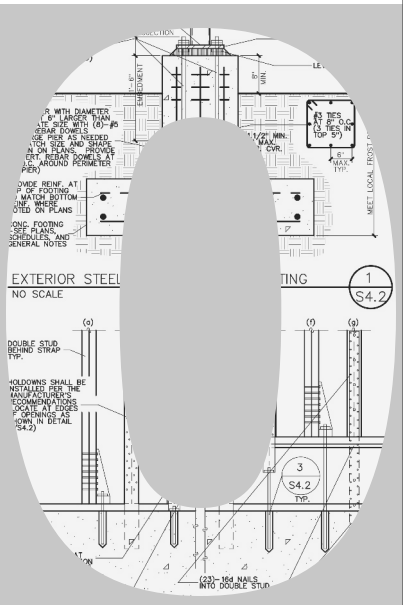
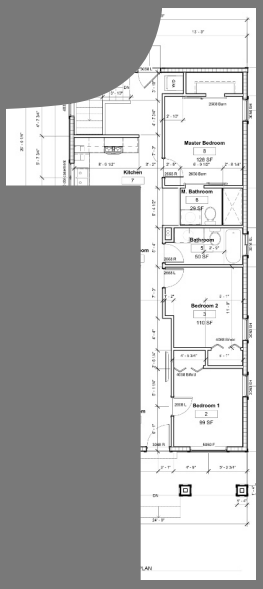




01 ARCHITECTURE

U.S. Department of Energy Solar Decathlon 2020

TEAM Net Zero

WEBER STATE UNIVERSITY

01. ARCHITECTURE

Students from Weber State University Department of Construction & Building Sciences made up the senior project team representing departments:

- Building Design & Construction
- Interior Design
- Construction Management

Our team constructed the all-electric home they designed, in collaboration with Ogden City, on the corner of 28th street and Quincy Avenue.

The 2,540 total square foot home (1270 on main and 1270 full finished basement) incorporates portable battery backup technology to allow the home to maintain critical loads for up to 72 hours if the electrical grid were to be down in a natural disaster or emergency. Not only will the Solar Array generate enough energy to offset the energy usage of the home annually, it will also generate enough electricity to charge an electric vehicle to travel 20 miles per day.

01. ARCHITECTURE

The lot was donated by Ogden City to show their commitment to revitalizing neighborhoods and breathing new life into historic districts.

This particular lot sat empty for nearly 10 years after a dilapidated 4-plex was torn down. The Craftsman Architectural Style home was intentionally designed to nestle in nicely with other homes on this historical avenue and showcase how a period style home can provide a net-zero energy lifestyle.

Students worked with city planners to design a home that would fit on the narrow deep lot. The home was 24' wide x 58' deep with a detached garage. Students were provided a set of plans that the city planners had designed that they were open to allowing us to alter to be part of the Solar Decathlon competition.

The design was dictated by the setback of the lot. It was a very difficult lot to build on because of it being a corner lot and having 20' setbacks from the back side of the existing sidewalks. A 6' setback on the west side required that windows be strategically placed so they didn't look directly into windows of the neighbors.

We discovered that the "free" lot that was donated by the city had a long list of issues. The debris from the old four plex had been buried on site and we spent an additional $20,000 hauling it away along with some dead trees and substantial root networks that required removal. An underground aquafer that ran through the site just a few inches below our footings which necessitated the installation of a perimeter and partial French drain that cost an additional $2,500.

We were required to replace all of the exiting sidewalk, curb, gutter, and existing driveway approaches left over from the four plex which cost an additional $25,000. The sewer lateral was only 4' below grade even though we were told it was deep enough to allow a gravity fed plumbing connection and therefore had to install an ejector pump to the cost of nearly $3,500. We were required to install new sewer and water laterals across the adjacent street which cost nearly $18,000.

01. ARCHITECTURE

From the street, other than the solar panels, there is no distinct differentiation that this home is a net positive all electric home capable of producing all of its own energy annually, maintaining all of its critical loads in excess of a week, as well as charging an electric car to drive up to 20 miles per day in the detached garage. This was on purpose! We wanted to prove that you can build a net zero home without it sticking out so it would appeal to a larger audience.

We designed large overhangs to nearly eliminate solar heat gain in the summer due to shade angles. We maximized the windows on the East side to allow solar heat gain in the winter, but limited the west facing windows and eliminated all windows on the south to minimize solar heat gain during the summer.

The view of the picturesque Rocky Mountains are to the East. All of the living space was intentionally placed on the East side of the home in conjunction with large windows to allow ample daylight and stunning sunrises and sunsets.

The home is long and narrow, therefore long site lines were designed to allow the feeling of a more open floor plan. All upstairs hallways were eliminated to open up the spacious feel of the floor plan and to accommodate for ADA accessibility.

All potential buyers who walked through the home commented on how much bigger it felt than it appeared from the exterior. We knew we were successful when the sub-contractors who were working on the build started asking if they could buy the home.

01. ARCHITECTURE

The color selection was reversed on the inside of the home to allow off white walls to be painted with a semi-gloss paint while applying color to the trim and doors. This allowed the natural light coming in from the large east facing windows to reflect off the paint sheen and flood the main floor.

The oversized basement windows allowed the same so there is no need to have artificial light during the day. These large windows help connect the occupant with the outdoors while also allowing for cross ventilation in the spring and fall to passively heat and cool the home.

We specified dark laminate vinyl planks throughout the main level to absorb solar heat gain and maximize the thermal mass advantages.

All efforts were made to use recycled materials, no VOC's, long life and energy efficient products. Cradle to cradle LVP was installed upstairs, along with budget friendly wool carpet.

The home is 100% LED fixtures with only the bathroom vanity lights requiring light bulbs.

We intentionally did not specify any materials that were not readily available in our local market. All products were sourced from big box stores, distributors or local hardware stores.

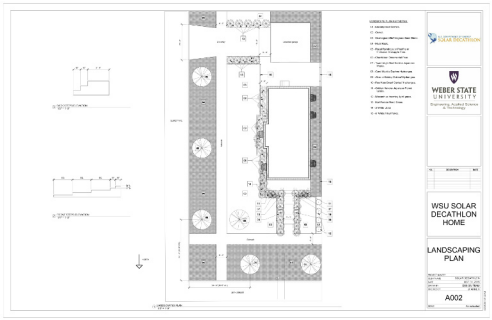
01. ARCHITECTURE

The yard was originally designed to be xeriscaped due to Utah being the 2nd driest state in the United States. However, this proved to be more expensive than estimated and didn't fit our affordability criteria for the project.

Drought tolerant sod was installed along with a digitally controlled, low flow, irrigation system. This particular sod is a "warm weather fescue grass mix", and requires 70% less water than traditional Kentucky bluegrass sod, often found in the Intermountain West as the only choice for landscapes. We sourced this turf grass from a family farm 130 miles North of Ogden.

Gravel and bark were placed on the west and south ends of the home and garage to reduce irrigation requirements.

All planter areas use drought tolerant, native plants and are irrigated with a drip system. Bark was placed over the top to help retain moisture and minimize evaporation.



01. ARCHITECTURE

The home is designed to make the "True Cost of Ownership" affordable to occupants of the east bench sector of Ogden by nearly eliminating all energy bills. It is estimated that the energy costs to operate the home will be just over $100 annually or around $9 per month to be connected to the electrical grid. The electrical grid essentially acts like a battery.

Excess energy not being used by the home during the day or on sunny day is put back on the grid for other neighbors and businesses to use, then the reverse is true when the home requires more energy than the solar array is producing, such as in the evening or on shady days. The net result of energy export and import is net-zero annually.

The home showcases technology such as Variable Refrigerant Flow HVAC, Air Source Heat Pump Water Heating, and Energy Recovery Ventilation to keep the super insulated and airtight home continuously sourced with fresh pre-conditioned air.

The building envelope of the home showcases off-the-shelf solutions that requires the super-efficient HVAC to only heat or cool the air within the home less than once an hour where most new homes today require the air to be conditioned 4-7 times per hour.

The foundation is built with Insulated Concrete Forms (ICFs) that have an effective R-Value of 45-55 and the main floor walls are panelized Structural Insulated Panels (SIPs) that have an effective R-Value of 27-29.

The roof utilizes Raised Heel Energy Trusses to allow the full depth R-49 insulation in the attic to be extended all the way out to the edge of the exterior walls. This helps to maintain conditioned air inside the home as well as prevent the leading cause of ice dams on homes in Utah.

Home Energy Rating System

are the guidelines used by the Department of Energy's Net-Zero Ready Homes Certification Checklist. To ensure our home met specific energy efficient design criteria we implemented this rating system on our project.

The Home Energy Rating System (HERS) Index is the industry standard by which a home's energy efficiency is measured. It's also the nationally recognized system for inspecting and calculating a home's energy performance.

A certified RESNET Home Energy Rater assesses the energy efficiency of a home, assigning it a relative performance score (the HERS Index Score). The lower the number, the more energy efficient the home. The U.S. Department of Energy has determined that a typical resale home scores 130 on the HERS Index while a home built to the 2006 International Energy Conservation Code is awarded a rating of 100.

The WSU Solar Decathlon home scored between 40-42 in the energy modeling phase depending on how much of the basement is finished which means it is 60% more efficient than homes built in Utah before March 2016.

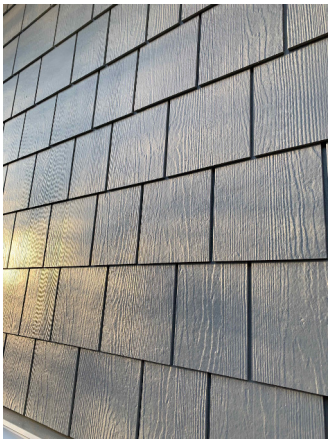
The WSU team loves to use the phrase "Build it Tight, Ventilate it Right". Their secret weapon is a new product they refer to as "magic fairy dust", or Aerobarrier, that will allow them to seal the home much tighter than is required by current energy code.

The home was air sealed using Aerobarrier to .6 ACH at 50 pascals of pressure.

01. ARCHITECTURE

Goodbye, thermal bridges.

We insulated and sealed the home to Passive House standards. None of this is evident to the untrained eye, nor was it significantly more expensive than traditional building practices. In fact, students assisted sub-contractors in assembling the foundation ICF blocks, shoring the walls up and pouring the concrete foundation walls. Students also assisted the setting of the SIPS and trusses. The trades who completed the exterior Hardi board siding didn't even know the difference.



The exterior envelope of the home uses Insulated Concrete Forms (ICFs) for the foundation that has an effective R-value of R49. The exterior walls are made of Structural Insulated Panels (SIPs)with an R-value of R29.

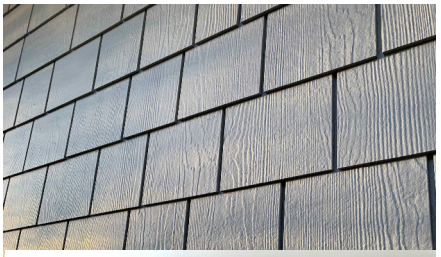
The roof trusses have a raised heal of 16" to allow full depth blown in fiberglass insulation to achieve an R60. The windows are triple low e coated glass filled with Argon gas and have a U factor of .27 or lower.

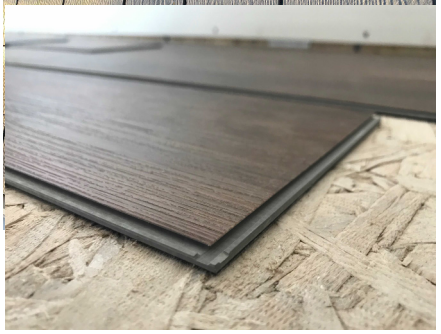
All appliances are Energy Star and water sense certified coupled with 100% LED, the home is extremely energy efficient.

An all-electric variable refrigerant flow HVAC system using mini-split technology takes the home to a whole new level of energy efficiency as energy can be displaced to other areas of the home that are calling for that energy in the form of heat or cooling. The HVAC system is designed to run in tandem with an Energy Recovery Ventilator (ERV) that eliminated all bathroom/laundry exhaust fans.

Traditional bathroom exhaust fans are replaced with exhaust air registers that are pulling 50 CFM of air out of the bathrooms/laundry constantly. The energy in this conditioned air is bypassed through a coil that transfers that energy into fresh air being pulled through the ERV and distributed into the common areas of the home.

ARCHITECTURAL PHOTOGRAPHY





ARCHITECTURAL PHOTOGRAPHY